Kubernetes

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- Docker overview
- Kubernetes
  - Core Concepts
  - Pods
  - Services
  - Labels
  - Namespaces, Annotations
  - Deployments
  - DaemonSets
  - ReplicaSets
  - Jobs
  - ConfigMaps and Secrets
  - Stateful set

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kubernetes

What is Kubernetes?

“Kubernetes is a portable, extensible open-source platform for managing containerized workloads and services, that facilitates both declarative configuration and automation. It has a large, rapidly growing ecosystem. Kubernetes services, support, and tools are widely available.”

Kubernetes

Kubernetes has a number of features. It can be thought of as:

- a container platform
- a microservices platform
- a portable cloud platform and a lot more.
- Kubernetes provides a container-centric management environment. It orchestrates computing, networking, and storage infrastructure on behalf of user workloads. This provides much of the simplicity of Platform as a Service (PaaS) with the flexibility of Infrastructure as a Service (IaaS), and enables portability across infrastructure providers.
- K8S Allows developers / system operators to cut to the cord and truly run a container-centric dev / microservice environment

Kubernetes
Core Concepts & Components

Kubernetes Concepts

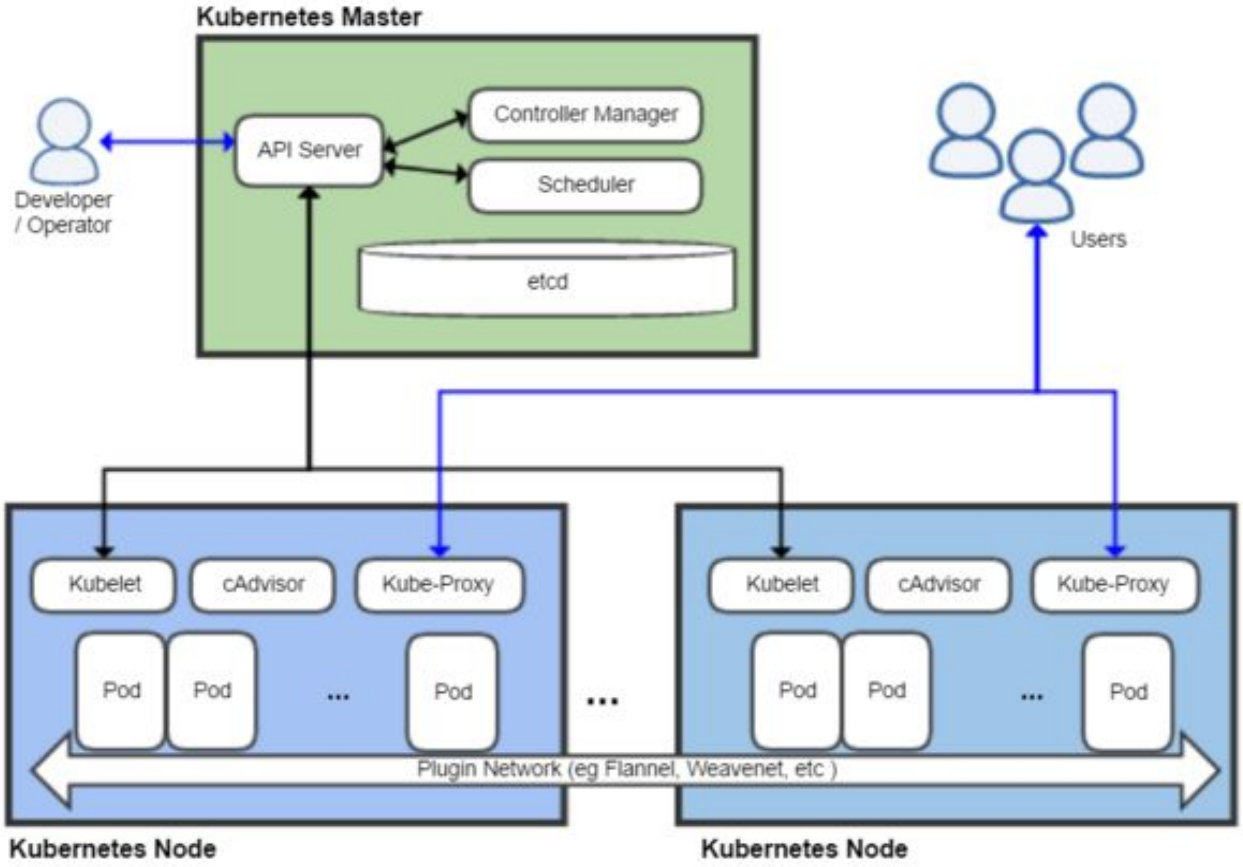
Understanding K8S system and abstraction

To work with Kubernetes, we use Kubernetes API objects to describe our cluster's desired state:

- what applications or other workloads we want to run
- What container images they use, the number of replicas, what network and disk resources we want to make available.
- Setting our desired state by creating objects using the Kubernetes API (typically via the command-line interface - kubectl)

Once we've set our desired state,
Kubernetes Control Plane works to make the **cluster's current state match the desired state**

Kubernetes


Kubernetes Master
API Server
Controller Manager
Scheduler
etcd
Developer
/ Operator
Users
Kubelet
cAdvisor
Kube-Proxy
Pod
Pod
...
Pod
...
Kubelet
cAdvisor
Kube-Proxy
Pod
Pod
...
Pod
Plugin Network (eg Flannel, Weavenet, etc)
Kubernetes Node
Kubernetes Node

K8S: Master Components

Master components provide the cluster's control plane

- **Kube-apiserver** - Validates and configures data for the api objects which include pods, services, replicationcontrollers, and others.
- **Kube-controller-manager** - is a an application control loop that watches the shared state of the cluster through the apiserver and makes changes attempting to move the current state towards the desired state.
- **Kube-scheduler** - its job is to take pods that aren't bound to a node, and assign them one along with hardware/software/policy constraints
- **etcd** - highly-available key value store used as Kubernetes' backing store for all cluster data

Non Master Kubernetes Components

- Each individual non-master node in our cluster runs two processes:
  - **Kubelet** - which communicates with the Kubernetes Master.
  - **Kube-proxy** - A network proxy which reflects Kubernetes networking services on each node.

Kubernetes Basics

Kubernetes Basics

To work with **Kubernetes objects**–whether to create, modify, or delete them–you'll need to use the Kubernetes API. When you use the kubectl command-line interface.

https://kubernetes.io/docs/concepts/overview/working-with-objects/kubernetes-objects/

https://kubernetes.io/docs/reference/kubectl/cheatsheet/

Kubernetes Building Blocks

Basic Kubernetes Object

- POD
- SERVICE
- VOLUME
- NAMESPACE

Controllers

- Deployment
- StatefulSet
- DaemonSet
- JOB
- ReplicaSet

Namespaces

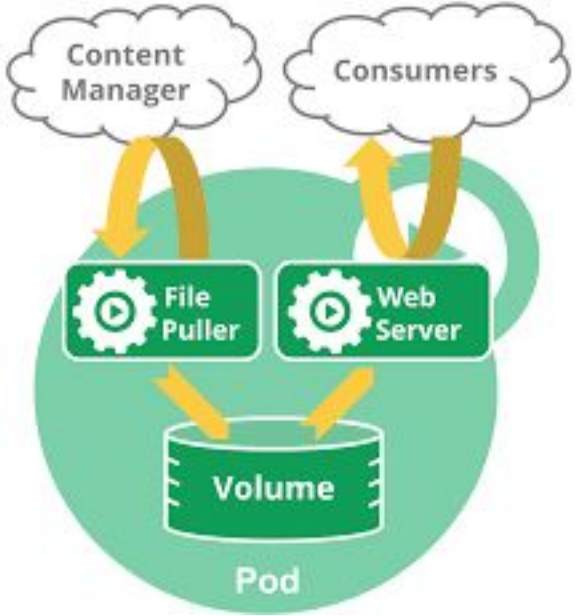
Kubernetes supports multiple virtual clusters backed by the same physical cluster. These virtual clusters are called namespaces.

Names of resources need to be unique within a namespace, but not across namespaces.
Namespaces can not be nested inside one another and each Kubernetes resource can only be in one namespace.

Namespaces are a way to divide cluster resources between multiple users

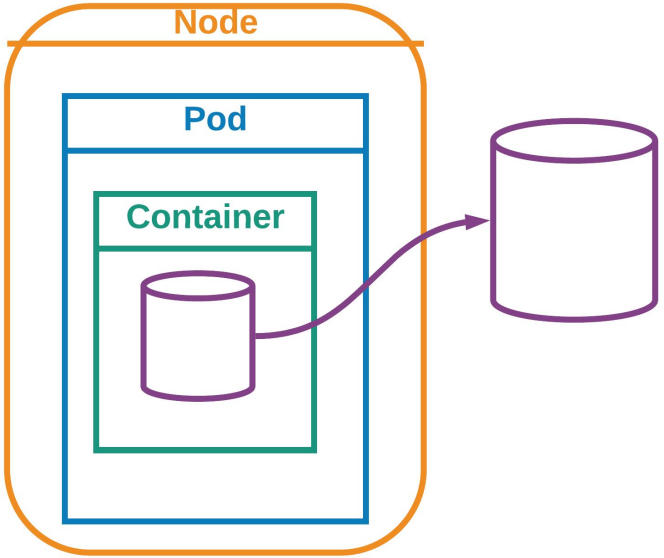
POD

- Basic building blocks.
  - Pods that run a single container
  - Pods that run multiple containers that need to work together



Volumes

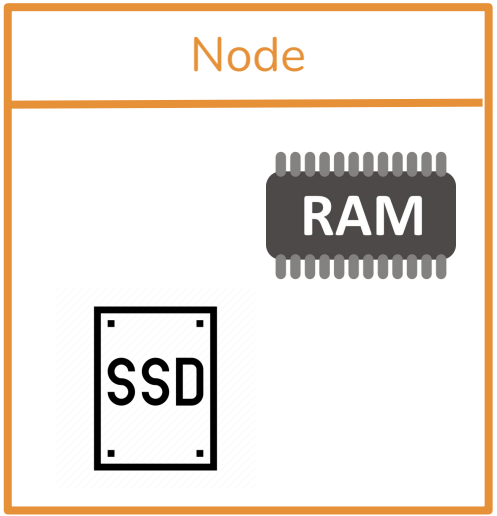
- Persistent Volume for save state.
- When running a container together in a Pod - share files between those containers.



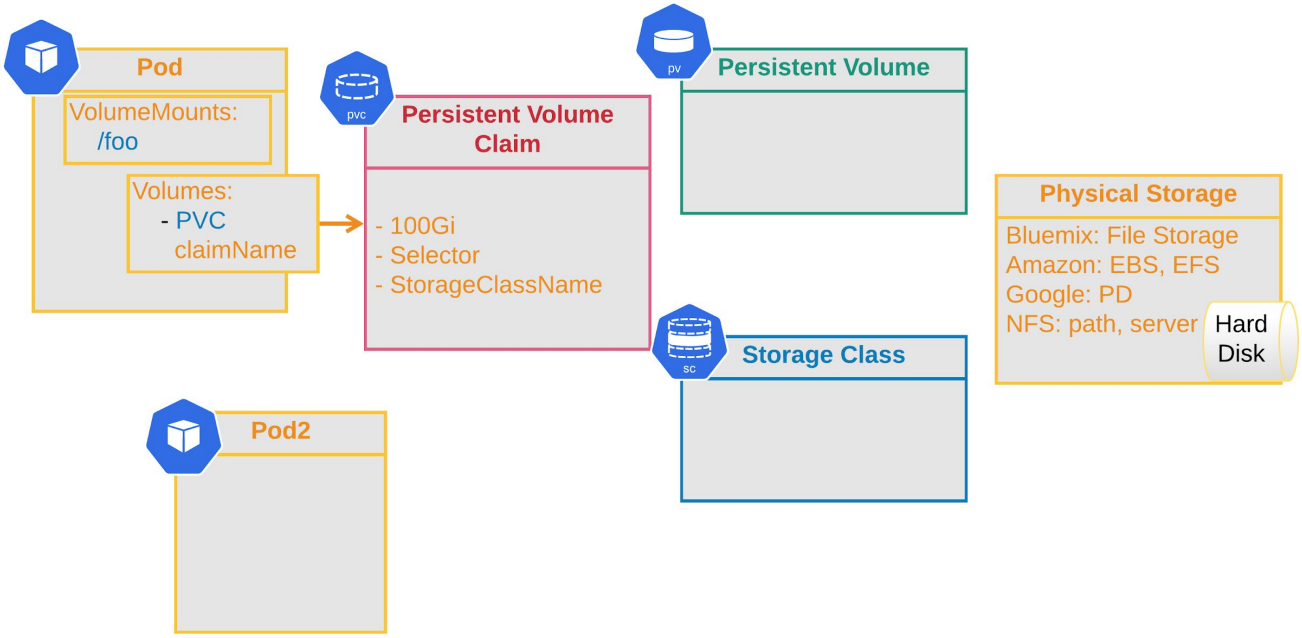
Volumes

- emptydir
- hostPath
- Cloud Volumes
- NFS
- Persistent Volume Claim

  PVC



Volumes

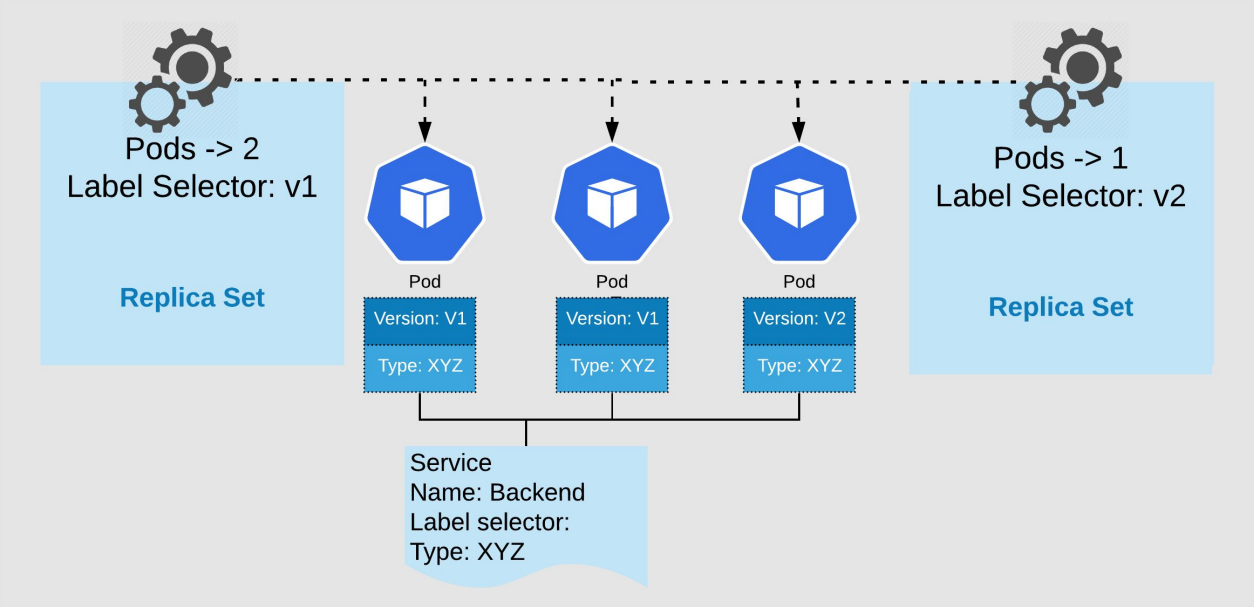

Pod
VolumeMounts:
/foo
Volumes:
- PVC
claimName
pvc
Persistent Volume Claim
- 100Gi
- Selector
- StorageClassName
pv
Persistent Volume
Physical Storage
Bluemix: File Storage
Amazon: EBS, EFS
Google: PD
NFS: path, server
Hard Disk
sc
Storage Class
Pod2

Labels and Selectors

- *Labels* are key/value pairs that are attached to objects, such as pods.
- *Labels* can be used to organize and to select subsets of objects.
- Each object can have a set of key/value labels defined. Each Key must be unique for a given object.

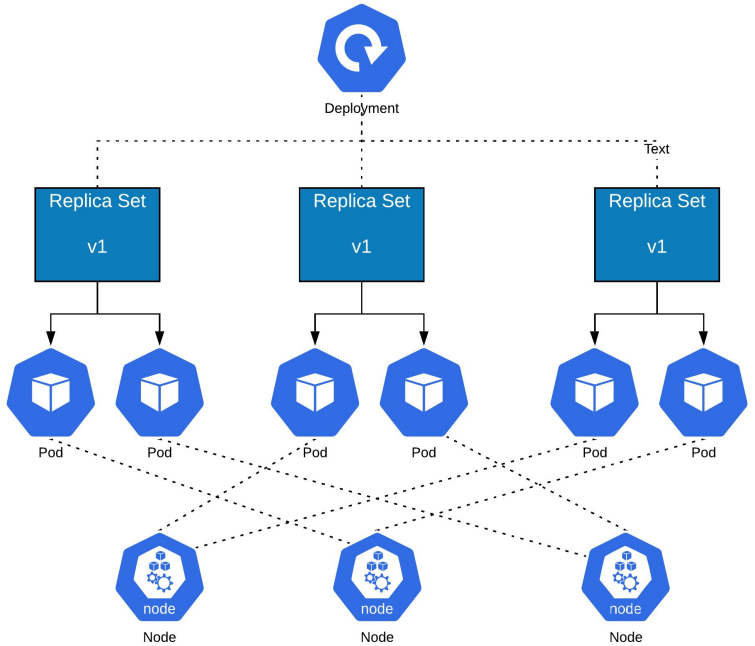
ReplicaSets

- ReplicaSet ensure how many replica of pod should be running. It can be considered as a replacement of replication controller.



Deployments

A controller that provides declarative updates for Pods and ReplicaSets. We describe a desired state in a Deployment object, and the Deployment controller changes the actual state to the desired state at a controlled rate.



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Deployments

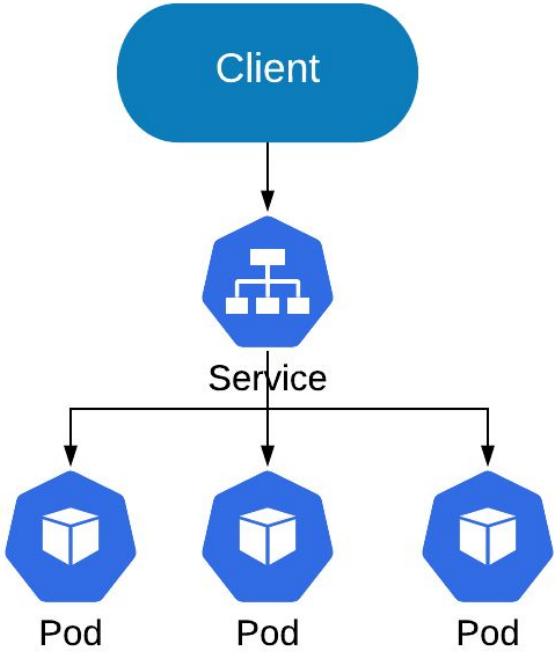
The strategy object dictates the different ways in which a rollout of new software can proceed. There are two different strategies supported by deployments: Recreate and RollingUpdate.

Deployment Use - Case

- **Create a Deployment:**
  A deployment is created. Once that is done the RplicaSet automatically creates Pods in the background.
- **Update Deployment:**
  A new ReplicaSet is created and the Deployment is updated. Each new ReplicaSet updates the revision of Deployment.
- **Rollback Deployment:**
  Used in case when the current state of the deployment is not stable. Only the container image gets updated.
- **Scale Deployment:**
  Each and every deployment can be scaled up or scaled down based on the requirement.
- **Pause the Deployment:**
  Pause the deployment to apply multiple fixes and then the deployment can be resumed.

Services

- ClusterIP
- NodePort
- LoadBalancer

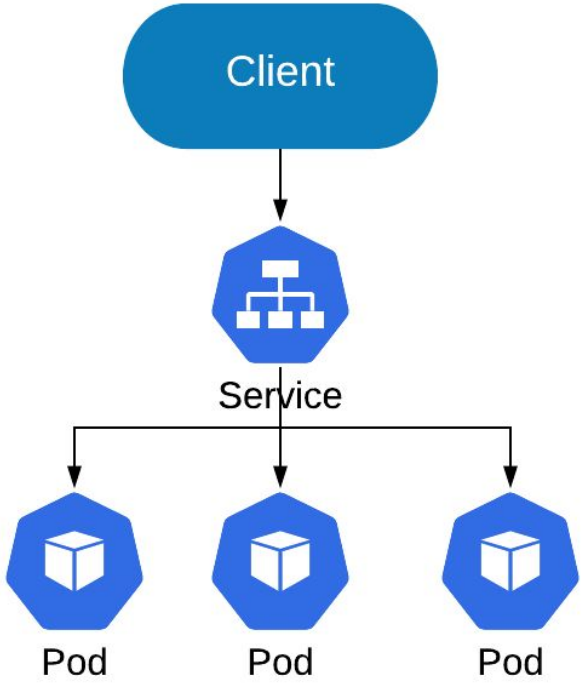


ClusterIP Service

ClusterIP

- Service **inside your cluster** that other apps inside your cluster can access.
- You can access it using k8s proxy:

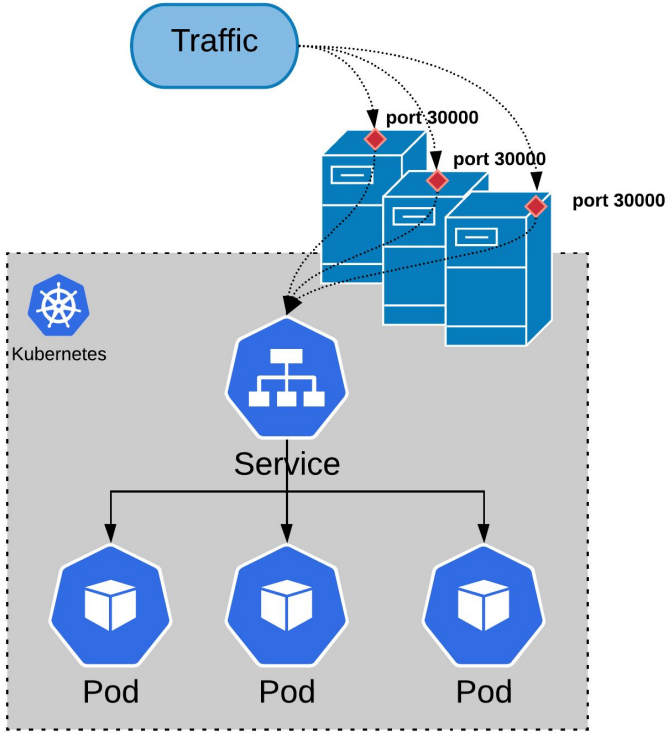
```
$ kubectl proxy --port=8080
```



NodePort Service

NodePort

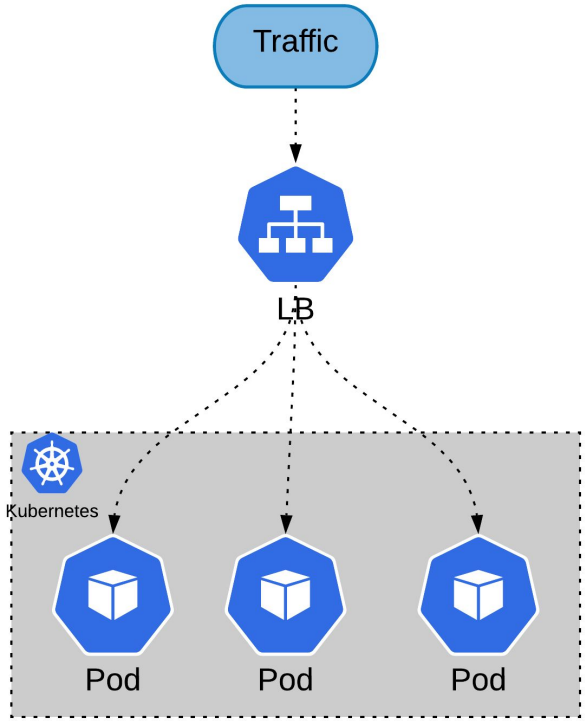
- Specific port on all the Nodes (the VMs) is open. (> 30000)
- Any traffic that is sent to this port is forwarded to the service.



LoadBalancer Service

LoadBalancer

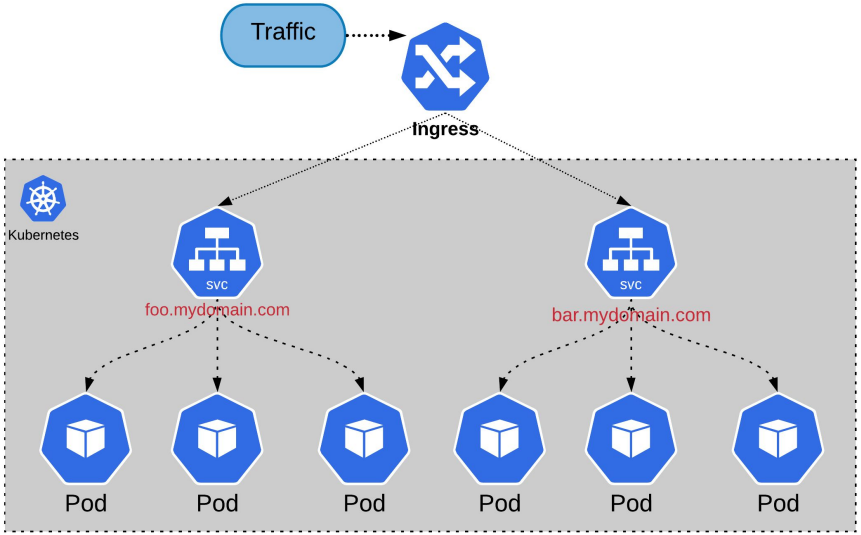
- External using network load balancer with a public IP.
- Standard way to expose a service to the internet.



Ingress

Ingress

- Ingress is a load balancer that will front multiple different pods.
- Traffic is routed via http URI or dns names.
- In GKE Ingress controller will spin up a HTTP(S) Load Balancer.



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ConfigMap

A ConfigMap is an API object used to store non-confidential data in key-value pairs. Pods can consume ConfigMaps as environment variables, command-line arguments, or as configuration files in a volume.

A ConfigMap allows you to decouple environment-specific configuration from your container images, so that your applications are easily portable.

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DaemonSet

A DaemonSet ensures a copy of a Pod is running across a set of nodes in a Kubernetes cluster. DaemonSets are used to deploy system daemons such as log collectors and monitoring agents, which typically must run on every node. DaemonSets share similar functionality with ReplicaSets; both create Pods that are expected to be long-running services and ensure that the desired state and the observed state of the cluster match.

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Jobs - Run to Completion

A Job creates one or more Pods and ensures that a specified number of them successfully terminate. As pods successfully complete, the Job tracks the successful completions. When a specified number of successful completions is reached, the task (ie, Job) is complete. Deleting a Job will clean up the Pods it created.

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StatefulSet

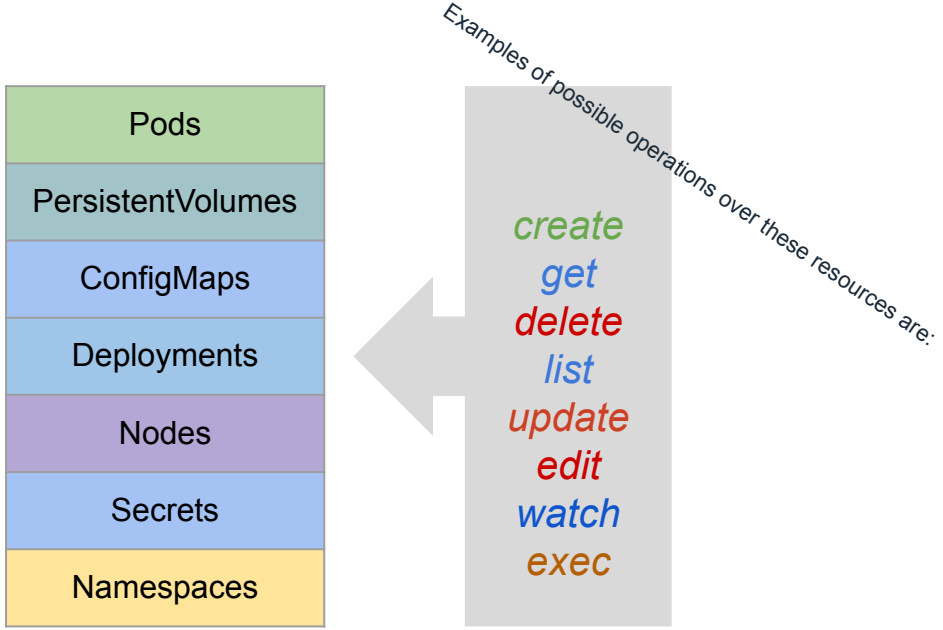
StatefulSets are valuable for applications that require one or more of the following.

- Stable, unique network identifiers.
- Stable, persistent storage.
- Ordered, graceful deployment and scaling.
- Ordered, automated rolling updates.

RBAC API Objects

One basic Kubernetes feature is that all its resources are modeled API objects, which allow CRUD (Create, Read, Update, Delete) operations.

Examples of resources are:



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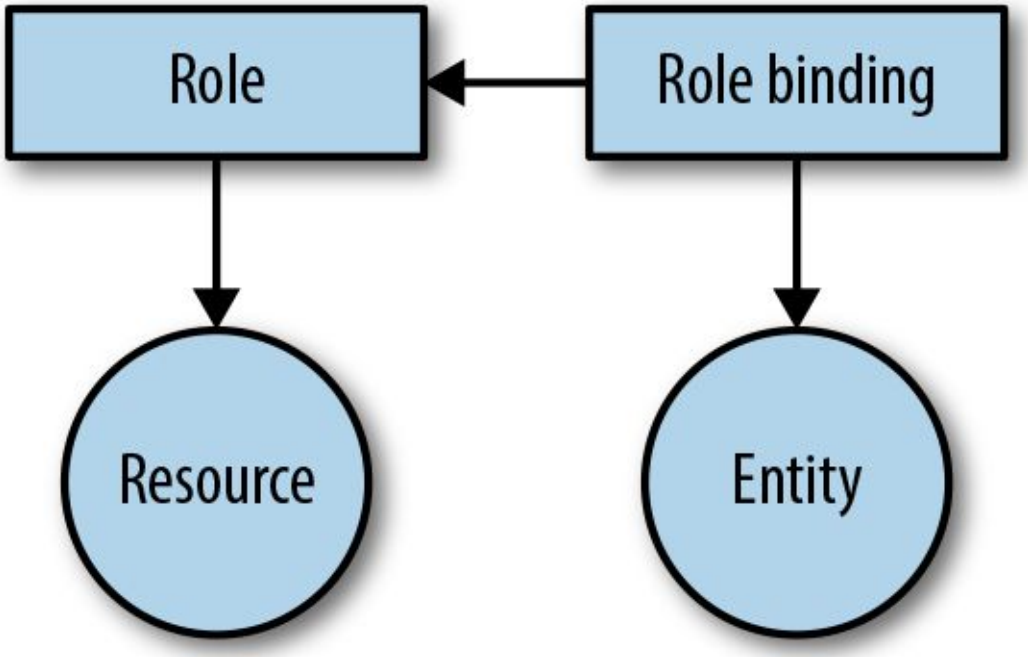
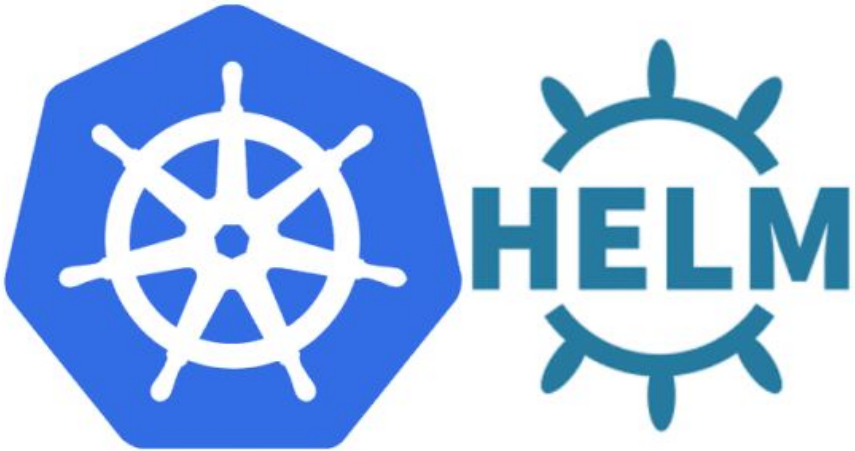
At a higher level, resources are associated with API Groups (for example, Pods belong to the *core* API group whereas Deployments belong to the *apps* API group). For more information about all available resources, operations, and API groups, check the Official Kubernetes API Reference.

To manage RBAC in Kubernetes, apart from resources and operations, we need the following elements:

- Rules
- Roles and ClusterRoles
- Subjects
- RoleBindigs

Follow tutorial:
https://docs.bitnami.com/kubernetes/how-to/configure-rbac-in-your-kubernetes-cluster/


Role
Role binding
Resource
Entity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Kubernetes Helm

Helm is a tool for managing Kubernetes packages called *charts*. Helm can do the following:

- Create new charts from scratch
- Package charts into chart archive (tgz) files
- Interact with chart repositories where charts are stored
- Install and uninstall charts into an existing Kubernetes cluster
- Manage the release cycle of charts that have been installed with Helm

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Three big concepts

A *Chart* is a Helm package. It contains all of the resource definitions necessary to run an application, tool, or service inside of a Kubernetes cluster. Think of it like the Kubernetes equivalent of a Homebrew formula, an Apt dpkg, or a Yum RPM file.

A *Repository* is the place where charts can be collected and shared. It's like Perl's CPAN archive or the Fedora Package Database, but for Kubernetes packages.

A *Release* is an instance of a chart running in a Kubernetes cluster. One chart can often be installed many times into the same cluster. And each time it is installed, a new *release* is created. Consider a MySQL chart. If you want two databases running in your cluster, you can install that chart twice. Each one will have its own *release*, which will in turn have its own *release name*.